IN THE CLAIMS

Please amend the claims as follows:

Claim 1 (Currently Amended): A transmitter of multicarrier signal for a mobile communication system, comprising:

a data channel generator multiplying a plurality of transmission data sequences by a plurality of short codes, respectively;

a long code multiplier multiplying the plurality of transmission data sequences multiplied by the plurality of the short codes by a common long code, respectively;

a synchronization signal generator multiplying a transmission data sequence for synchronization signal only by a spreading code for synchronization signal; and

a transmission element transmitting, by using a plurality of subcarriers, the transmission data sequences doubly multiplied by the short code and the long code, and transmitting the synchronization signal multiplied only by the spreading code for synchronization signal, wherein the synchronization signal generator multiplies the synchronization signal by the spreading code for synchronization signal at plural timings in a predetermined interval.

Claim 2 (Cancelled).

Claim 3 (Currently Amended): A multicarrier signal transmission method for a mobile communication system, comprising:

transmitting, by using a plurality of subcarriers, a data sequence doubly multiplied by a short code and a long code; and

transmitting in a burst mode at specific intervals, by using one for a plurality of subcarriers, a synchronization signal multiplied only by a spreading code for synchronization signal.

Claim 4 (Cancelled).

Claim 5 (Currently Amended): A method as in claim 3 ~~or 4~~, wherein:

a pattern of the spreading code of synchronization signal applied to the synchronization signal indicates a received timing transmitted timing of long code.

Claim 6 (Currently Amended): A method as in claim 3, wherein a ~~timing~~ transmitted timing of the synchronization signal indicates a received timing ~~transmitted timing~~ of the long code.

Claim 7 (Currently Amended): A method as in claim 3, wherein a ~~timing~~ transmitted timing of the synchronization signal and the subcarrier in which the synchronization signal is transmitted indicate a received timing ~~transmitted timing~~ of the long code.

Claim 8 (Cancelled).

Claim 9 (Currently Amended): A receiver of multicarrier signal for a mobile communication system, the system transmits, by using a plurality of subcarriers, a data sequence doubly multiplied by a short code and a long code chosen from a long code group, comprising:

a receiving element receiving the multicarrier signal containing the subcarriers, at least one of which includes a synchronization signal ~~is~~ transmitted therein, multiplied only by a spreading code for synchronization ~~signal~~;

a first correlator detecting correlation values between the received multicarrier signal and synchronization signal replicas;

a timing detector detecting an FFT timing and a received timing of long code according to the correlation values;

an FFT unit carrying out FFT at the detected FFT timing, to separate the received multicarrier signal a plurality of subcarrier components;

a second correlator detecting, at the detected received timing of long code, correlation values between the subcarrier components and a plurality of replicas of data sequence doubly multiplied by a short code and each long code chosen from a long code group;

a code detector detecting, according to the detected correlation values, a long code that is scrambling the received multicarrier signal; and

a demodulation circuit demodulating the data sequence from the received multicarrier signal by using the received timing of long code and the long code.

Claim 10 (Cancelled).

Claim 11 (Currently Amended): A receiver of multicarrier signal for a mobile communication system, the system transmits, by using a plurality of subcarriers, a data sequence doubly multiplied by a short code and a long code chosen from a long code group, comprising:

a receiving element receiving the multicarrier signal containing the subcarriers, at least one of which includes a synchronization signal ~~is~~ transmitted therein, multiplied only by a spreading code for synchronization ~~signal~~;

a subcarrier separator carrying out FFT operations at a plurality of FFT timing candidates to separate the received multicarrier signal into a plurality of subcarrier components;

a first correlator detecting correlation values between the subcarrier components that carry the synchronization signal and a synchronization signal replica;

a timing detector detecting a received timing of long code and an FFT timing according to the correlation values;

an FFT unit carrying out FFT operation at the detected FFT timing to separate the received multicarrier signal into a plurality of subcarrier components;

a second correlator detecting, at the detected received timing of long code, correlation values between the subcarrier components and a plurality of replicas of data sequence doubly multiplied by a short code and each code chosen from a long code group;

a code detector detecting, according to the detected correlation values, a long code that is scrambling the received multicarrier signal; and

a demodulation circuit demodulating the data sequence from the received multicarrier signal by using the received timing of long code and the long code.

Claim 12 (Cancelled).

Claim 13 (Currently Amended): A receiver of multicarrier signal for a mobile communication system, the system transmits, by using a plurality of subcarriers, a data

sequence doubly multiplied by a short code and a long code chosen from a long code group, comprising:

a receiving element receiving the multicarrier signal containing the subcarriers, at least one of which includes a synchronization signal ~~is~~ transmitted therein, multiplied only by a spreading code for synchronization ~~signal~~;

a subcarrier separator separating the received multicarrier signal into a plurality of subcarrier components;

a first correlator detecting correlation values between the subcarrier components that carry the synchronization signal and a synchronization signal replica; and

a timing detector detecting a received timing of long code according to the correlation values;

a second correlator detecting, at the detected received timing of long code, correlation values between the subcarrier components and a plurality of replicas of data sequence doubly multiplied by a short code and each code chosen from a long code group;

a code detector detecting, according to the detected correlation values, a long code that is scrambling the received multicarrier signal; and

a demodulation circuit demodulating a data sequence from the received multicarrier signal by using the received timing of long code and the long code.

Claim 14 (Currently Amended): A receiver of multicarrier signal for a mobile communication system, the system transmits, by using a plurality of subcarriers, a data sequence doubly multiplied by a short code and a long code chosen from a long code group, comprising:

a receiving element receiving the multicarrier signal containing the subcarriers, at least one of which includes a synchronization signal ~~is~~ transmitted therein, multiplied only by a spreading code for synchronization ~~signal~~;

a subcarrier separator carrying out FFT operations at a plurality of FFT timing candidates to separate the received multicarrier signal into plural groups each of which contains a plurality of subcarrier components;

a first correlator detecting correlation values between the subcarrier components that carry the synchronization signal and a synchronization signal replica for each groups of subcarriers;

a timing detector detecting a plurality of candidates of long code received timing according to the correlation values detected by the first correlator;

a second correlator detecting, at each of the detected candidates of long code received timing, correlation values between the subcarrier components and a plurality of replicas of data sequence doubly multiplied by a short code and each code chosen from a long code group;

a code candidate detector detecting, according to the correlation values detected by the second correlator, a plurality of candidates of long code for scrambling a multicarrier signal;

a timing and code detector detecting a received timing of long code among the received timing candidates and detecting a long code among the candidates of long code; and

a demodulation circuit demodulating the data sequence from the received multicarrier signal by using the received timing of long code and the long code.

Claim 15 (Cancelled).

Claim 16 (Currently Amended): A receiver of multicarrier signal for a mobile communication system, the system transmits, by using a plurality of subcarriers, a data sequence doubly multiplied by a short code and a long code chosen from a long code group, comprising:

a receiving element receiving the multicarrier signal containing the subcarriers, at least one of which includes a synchronization signal ~~is~~ transmitted therein, multiplied only by a spreading code for synchronization ~~signal~~;

an FFT timing detector detecting a correlation for a guard interval of the received multicarrier signal, to detect an FFT timing;

a subcarrier separator carrying out FFT at the FFT timing to separate the received multicarrier signal into a plurality of subcarrier components;

a first correlator detecting correlation values between subcarriers that carry a synchronization signal among the separated subcarriers and a synchronization signal replica;

a timing detector detecting a received timing of long code according to the correlation values;

a second correlator detecting, at the detected received timing of long code, correlation values between the subcarrier components and a plurality of replicas of data sequence doubly multiplied by a short code and each code chosen from a long code group;

a code detector detecting, according to the detected correlation values, a long code that is scrambling the received multicarrier signal; and

a demodulation circuit demodulating the data sequence from the received multicarrier signal by using the received timing of long code and the long code.

Claim 17 (Currently Amended): A multicarrier signal receiving method for a mobile communication system, the system transmits, by using a plurality of subcarriers, a data

sequence doubly multiplied by a short code and a long code chosen from a long code group, comprising:

a receiving step of receiving the multicarrier signal containing the subcarriers, at least one of which includes a synchronization signal ~~is~~ transmitted therein in a burst mode at specific intervals, multiplied only by a spreading code for synchronization ~~signal~~;

a correlation detection step of detecting correlation values between the received multicarrier signal and synchronization signal replicas; ~~and~~

a timing detection step of detecting an FFT timing and a received timing of the long code according to the correlation values;

a separation step of carrying out FFT at the detected FFT timing, to separate the received multicarrier signal into a plurality of subcarrier components;

another correlation detection step of detecting, at the detected received timing of the long code, correlation values between the subcarrier components and a plurality of replicas of the data sequence doubly multiplied by a short code and each code chosen from a long code group; and

a code detection step of detecting, according to the detected correlation values, a long code that is scrambling the received multicarrier signal.

Claim 18 (Currently Amended): A multicarrier signal receiving method for a mobile communication system, the system transmits, by using a plurality of subcarriers, a data sequence doubly multiplied by a short code and a long code chosen from a long code group, comprising:

a receiving step of receiving the multicarrier signal containing the subcarriers, at least one of which includes a synchronization signal ~~is~~ transmitted therein in a burst mode at specific intervals, multiplied only by a spreading code for synchronization ~~signal~~;

a separation step of separating the received multicarrier signal into a plurality of subcarrier components;

a correlation detection step of detecting correlation values between the subcarrier components that carry the synchronization signal and a synchronization signal replica; and

a timing detection step of detecting a received timing of long code according to the correlation values, wherein

the separation step carries out FFT at a plurality of FFT timing candidates;

the correlation detection step detects the correlation values for each FFT timing candidate; and

the timing detection step detects an FFT timing and the receive timing of the long code according to the correlation values.

Claim 19 (Cancelled).

Claim 20 (Currently Amended): A method as in claim ~~17 or~~ 19, further comprising:

a separation step of carrying out FFT at the detected FFT timing, to separate the received multicarrier signal into a plurality of subcarrier components;

another correlation detection step of detecting, at the detected received timing of long code, correlation values between the subcarrier components and a plurality of replicas of data sequence doubly multiplied by a short code and each code chosen from a long code group; and

a code detection step of detecting, according to the detected correlation values, a long code that is scrambling the received multicarrier signal.

Claim 21 (Currently Amended): A multicarrier signal receiving method for a mobile communication system, the system transmits, by using a plurality of subcarriers, a data sequence doubly multiplied by a short code and a long code chosen from a long code group, comprising:

a receiving step of receiving the multicarrier signal containing the subcarriers, at least one of which includes a synchronization signal is transmitted therein, multiplied only by a spreading code for synchronization ~~signal~~;

a separation step of carrying out FFT on the received multicarrier signal at a plurality of FFT timing candidates, to separate the received multicarrier signal into a plurality of subcarrier components for each FFT timing candidate;

a first correlation detection step of detecting correlation values between the subcarrier components that carry the synchronization signal and a synchronization signal replica;

a timing detection step of detecting a received timing of long code according to the correlation values;

a second correlation detection step of detecting, at the detected received timing of long code, correlation values between the subcarrier components and a plurality of replicas of data sequence doubly multiplied by a short code and each code chosen from a long code group; and

a timing and code detection step of detecting an FFT timing, a received timing of long code, and the long code that is scrambling the received multicarrier signal according to the detected correlation values for each of the FFT timing candidates in the second correlation detection step.

Claim 22 (Currently Amended): A multicarrier signal receiving method for a mobile communication system, the system transmits in a burst mode at specific intervals, by using a

plurality of subcarriers, a data sequence doubly multiplied by a short code and a long code chosen from a long code group, comprising:

an FFT timing detection step of detecting an FFT timing according to a correlation characteristic of a guard interval contained in the received multicarrier signal;

a separation step of carrying out FFT at the detected FFT timing, to separate the received multicarrier signal into a plurality of subcarrier components;

a correlation detection step of detecting correlation values between subcarriers that carry a synchronization signal among the separated subcarriers and a synchronization signal replica; ~~and~~

a timing detection step of detecting a received timing of long code according to the correlation values;

another correlation detection step of detecting, at the detected received timing of the long code, correlation values between the subcarrier components and a plurality of replicas of the data sequence doubly multiplied by a short code and each code chosen from a long code group; and

a code detection step of detecting, according to the detected correlation values, a long code that is scrambling the received multicarrier signal.

Claim 23 (Cancelled).

Claim 24 (Currently Amended): A receiver of multicarrier signal for a mobile communication system, the system transmits, by using a plurality of subcarriers, a data sequence doubly multiplied by a short code and a long code chosen from a long code group, comprising:

a receiving element receiving the multicarrier signal containing the subcarriers, at least one of which includes a synchronization signal ~~is~~ transmitted therein, multiplied only by a spreading code for synchronization ~~signal~~; and

an FFT timing detector detecting a plurality of FFT timing candidates according to a correlation characteristic of a guard interval contained in the received multicarrier signal; wherein

the FFT timing detector comprises:

a multiplier multiplying the received multicarrier signal by a delayed signal by one symbol length of the received multicarrier signal, to provide a product;

an integrator integrating the product over one guard interval at every guard interval, to provide a plurality of correlation values;

a first memory storing the correlation values and corresponding timings thereto;

a second memory storing a plurality of FFT timing candidates consecutively given;

a search range setter setting search ranges for respective FFT timing candidates according to the correlation values in the first memory and the FFT timing candidates in the second memory; and

a timing detector firstly selecting a maximum correlation value and a corresponding timing from the values in the first memory as an FFT timing candidate #1 and storing the FFT timing candidate #1 in the second memory, subsequently making the search rang setter set a new search range according to the values stored in the first memory and the FFT timing candidate previously stored in the second memory, selecting a maximum correlation value and a corresponding timing from the values within the search range previously set as an FFT timing candidate #2 and

storing the FFT timing candidate #2 in the second memory, and repeating the same operations of setting a new search range and selecting an FFT timing candidate of next number until detecting a predetermined number of FFT timing candidates.

Claim 25 (Original): A receiver as in claim 24, further comprising:

a plurality of FFT units, each of which carries out FFT operations to the received multicarrier signal at each of detected plural FFT timing candidates to separate the received multicarrier signal into a plurality of subcarrier components;

a plurality of first correlators, each of which detects correlation values between the subcarrier components that carry the synchronization signal and a synchronization signal replica for each groups of subcarriers;

a plurality of timing detectors, each of which detects a plurality of received timing candidates of long code;

a plurality of second correlators, each of which detects, at each received timing candidate of long code, correlation values between the subcarrier components and a plurality of replicas of data sequence doubly multiplied by a short code and each code chosen from a long code group;

a plurality of code candidate detectors, each of which detects, according to the detected correlation values, a plurality of candidates of long code for scrambling a multicarrier signal;

a timing and code detector detecting a received timing of long code among the received timing candidates and detecting a long code among the candidates of long code; and

a demodulation circuit demodulating the data sequence from the received multicarrier signal by using the received timing of long code and the long code.

Claim 26 (Original): A receiver as in claim 24, further comprising:

a plurality of first FFT units, each of which carries out FFT operations to the received multicarrier signal at each of detected plural FFT timing candidates to separate the received multicarrier signal into a plurality of subcarrier components;

a plurality of first correlators, each of which detects correlation values between the subcarrier components that carry the synchronization signal and a synchronization signal replica for each group of subcarriers;

a timing detector detecting a received timing of long code and an FFT timing according to the correlation values;

a second FFT unit carrying out FFT operation at the detected FFT timing to the received multicarrier signal to separate a plurality of subcarriers;

a second correlator detecting, at the received timing of long code, correlation values between the subcarrier components and a replica of data sequence doubly multiplied by a short code and each code chosen from a long code group;

a code detector detecting, according to the detected correlation values, a long code for scrambling a multicarrier signal; and

a demodulation circuit demodulating the data sequence from the received multicarrier signal by using the received timing of long code and the long code.

Claim 27 (Currently Amended): A multicarrier signal receiving method for a mobile communication system, the system transmits, by using a plurality of subcarriers, a data sequence doubly multiplied by a short code and a long code chosen from a long code group, comprising:

an FFT timing detection step of detecting a plurality of FFT timing candidates according to a correlation characteristic of a guard interval contained in a received multicarrier signal, wherein the FFT timing detection step comprises

a multiplication step of multiplying the received multicarrier signal by a delayed signal by one symbol length of the received multicarrier signal, to provide products;

an integrating step of integrating the products over the period that is equal to a guard interval, to provide correlation value sequences;

an averaged correlation value step of accumulating coherently the correlation value sequences during each insertion period of guard interval, to provide averaged correlation value averaged correlation value sequence averaged correlation value sequence, which having a time length equivalent to the insertion period of guard interval; and

an FFT timing detection step of detecting the plural FFT timing candidates according to the averaged correlation value averaged correlation value sequence.

Claim 28 (Cancelled).

Claim 29 (Currently Amended): A method as in claim ~~28~~27, wherein the FFT timing detection step comprising:

a step of detecting a timing corresponding to a maximum averaged correlation value in the sequence of the averaged correlation values as a first FFT timing candidate; and

a step of setting predetermined W sampling periods around the first FFT timing candidate as an exclusion window, detecting, as a next FFT timing candidate, a timing corresponding to a maximum averaged correlation value in the sequence of averaged correlation values excluding the exclusion window, and repeating the setting of an exclusion

window and the detecting of a next FFT timing candidate, to provide a predetermined number of FFT timing candidates.

Claim 30 (Original): A method as in claim 29, wherein:

each exclusion window is set by predetermined W/2 sampling periods before and behind a previously detected FFT timing candidate.

Claim 31 (Original): A method as in claim 29, wherein a size and position of each exclusion window are set according to an inclination of the sequence of averaged correlation values around a previously detected FFT timing candidate.

Claim 32 (Original): A method as in claim 29, wherein a size and position of each exclusion window are set according to the averaged correlation value corresponding to a previously detected FFT timing candidate.

Claim 33 (Currently Amended): A method as in one of claims ~~28~~ 27 and 29 to 32, further comprising:

a step of setting additional FFT timing candidates before and behind each of the determined FFT timing candidates.

Claim 34 (Currently Amended): A method as in one of claims ~~28~~ 27 and 29 to 33, further comprising:

a step of carrying out FFT at a plurality of the detected FFT timing candidates, to separate the received multicarrier signal into a plurality of subcarrier components;

a step of detecting correlation values between subcarriers that carry a synchronization signal among the separated subcarriers and a synchronization signal replica;

a step of detecting one or a plurality of received timing candidates of the long code according to the detected correlation values;

a step of detecting, at respective timings of the detected received timing candidates of the long code, correlation values between the subcarrier components and a plurality of replicas of data sequence doubly multiplied by a long code chosen from a long code group and a short code; and

a step of detecting an FFT timing, a received timing of long code, and a long code that is scrambling the received multicarrier signal according to the detected correlation values.

Claim 35 (Original): A multicarrier signal receiving method for a mobile communication system, the system transmits, by using a plurality of subcarriers, a data sequence doubly multiplied by a short code and a long code chosen from a long code group, comprising:

detecting correlation values between the subcarrier components separated from a received multicarrier signal and a plurality of replicas of data sequence doubly multiplied by a long code chosen from a long code group and a short code, by:

integrating the product coherently over Navg symbols along a time axis for each subcarrier, where Navg is an integer equal to or larger than 1;

accumulating coherently the integrated value of each subcarrier for Ncs consecutive subcarriers along a frequency axis, where Ncs is an integer satisfying 1<=Ncs<=N, and N is the number of the subcarriers; and

detecting averaged correlation values by averaging Nps accumulated value of every Ncs subcarriers by squared form along the frequency axis, wherein Nps is an integer satisfying 1<=Nps<=Nc/Ncs.

Claim 36 (Original): A method as in claim 35, wherein if Nps<(N/Ncs), alternately detecting correlation values of (N/Ncs)/Nps long codes at the intervals of Ncs subcarriers along the frequency axis.